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Journal of the Society of Arts.

FRIDAY, MARÇH 20, 1857.

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NOTICE TO CANDIDATES.

Persons who intend to offer themselves as Candidates at the Society's Examinations in June next, in London and at Huddersfield, are desired to take notice that no one will be admitted to the Examinations who shall not have sent in his "Return paper" to the Secretary of the Society of Arts, before Monday, the 20th of April next.

EXHIBITION OF INVENTIONS.

The Society's Ninth Annual Exhibition of Inventions will be opened on Monday next, the 23rd instant. The Exhibition will be open every day till the 23rd of May, from 10 a.m. to 4 p.m., and is free to the members and their friends. Members, by tickets or by written order bearing their signature, may admit any number of friends.

FIFTEENTH ORDINARY MEETING.

Wednesday, March 18, 1857.

The Fifteenth Ordinary Meeting of the One Hundred and Third Session was held on Wednesday, the 18th inst., Professor Owen, F.R.S., in the chair.

The following Candidates were balloted for, and duly elected members of the Society:—

Blackmore, Martin
Field, William
Forster, W. E.
Freston, W. A.
Garland, Rev. George
Holland, William
Ludlam, Henry
Moxon, Thomas
Plummer, Benjamin, jun.
Shapcott, George Parkman
Smith, Thomas Mosdell.

The Paper read was:—

ON THE ECONOMY OF FOOD.

By Dr. Letheby, Professor of Chemistry in the College of the London Hospital, and Officer of Health for the City of London.

The statistics of crime, disease, mortality, and even of the general prosperity of a country, are intimately associated with all that concerns the supply of food to the people; the question, therefore, of the economy of food, by which I mean the facts of its production, distribution, and proper appropriation, is of great importance, for it alike commands the attention of the philanthropist, the philosopher, and the statesman.

I regret that the time at my disposal this evening will not permit me to enter upon those parts of the subject which concern the production of food and its supply. I must confine myself, as closely as possible, to those facts which have been clearly made out respecting the proper appropriation of it.

Hardly 20 years have elapsed since chemists and physiologists began to turn their attention to the composition of food, and the uses of its several constituents; but in the course of that time, the labours of Prout, Liebig, Dumas, Boussingault, Playfair, Johnston, Mulder, Lehmann, Persoz, Bernard, Payen, and others, have developed a body of facts, which, although of gigantic proportions, may yet be comprehended in a very simple expression, namely, that the various alimentary substances made use of by man and animals, contain at least four classes of constituents, each of which performs its own assigned function in the living animal economy. If the substance contains nitrogen, it usually serves for the nourishment of tissue, and is called plastic or nitrogenous; if it is deficient in nitrogen, but has an excess of carbon or hydrogen, it then undergoes combustion in the body, and is called the non-nitrogenous or respiratory; if it is fatty in its nature, it performs the double duty of maintaining animal warmth, and of assisting in the assimilation of nitrogenous compounds; and, lastly, if it is saline in its quality, it goes to build up the solid textures of the animal frame, and also does the important work of carrying new materials into the system and old ones out of it. Man and animals are alike in this particular—that they cannot live upon food which does not contain all these classes of constituents. Experience, and common instinct tell us also, that these classes must be associated in due proportion. In fact, a survey of the different kinds of food made use of by different nations, and of the peculiar habits of feeding which characterise particular classes of individuals, will show that there is ever an instinctive struggle to bring together, and to maintain in right proportion, these several constituents of food. This fact has been so forcibly expressed by a recent writer, the late Mr. Johnston, that I shall offer no apology for freely quoting him.

A glance at the table before you will show that different kinds of food contain different proportions of the four proximate principles to which I have referred; and, if we regard human milk as the type or model of what our food should be, it will be seen that whenever we partake of any aliment that is naturally deficient in one or more of these principles, we endeavour to increase it by art, as by using it with some

Table I.

NUTRITIVE VALUE OF FOODS.

Substances, 100 parts.	Water.	Fibrine Albumen, &c.	Starch, Sugar, &c.	Fat.	Salts.	Carboniferous.	Nitrogenous.	Total Nutriment.
Human Milk......	89	3 5	4.2	3.0	0.2	11.4	3.5	14.9
Cows Milk	86	4.5	5.0	4.1	0.7	14.8	4.5	19.3
Skimmed Milk...	87	4.5	5.0	2.7	0.7	11.5	4.5	16.0
Butter Milk	87	4.5	5.0	0.5	0.7	6.0	4.5	10.5
Beef and Mutton.	73	19.0	...	5.0	2.0	12.0	19.0	31.0
Veal................	77	19.0	...	1.0	0.6	2.4	19.0	21.4
Poultry	74	21.0	...	3.0	1.2	7.2	21.0	128.2
Bacon..............	20	0.8	...	70.0	1.3	168.0	0.8	168.8
Cheese (Chedder)	36	29.0	...	30.0	4.5	72.0	29.0	01.0
,, (Skimmed)	44	45.0	...	6.0	5.0	14.4	45.0	159.4
Butter..............	15	...	...	83.0	2.0	199.0	...	99.0
Eggs................	74	14.0	...	10.5	1.5	25.0	14.0	39.0
White of Egg.....	78	20.0	...	...	1.6	—	20.0	20.0
Yolk of Egg	52	16.0	...	30.0	1.3	72.0	16.0	88.0
White Fish........	79	19.0	...	1.0	1.2	2.4	19.0	21.4
Salmon	78	17.0	...	4.0	1.4	9.6	17.0	26.6
Eel	80	10.0	...	8.0	1.3	19.2	10.0	29.2
Wheat Flour......	15	11.0	70.0	2.0	1.7	74.8	11.0	85.8
Barley-meal	15	10.0	70.0	2.4	2.0	75.8	10.0	85.8
Oat-meal...........	15	12.0	62.0	6.0	3.0	76.4	12.0	88.4
Rye-meal	15	9.0	66.0	2.0	1.8	70.8	9.0	79.8
Indian-meal.......	14	9.0	65.0	8.0	1.7	84.2	9.0	93.2
Rice	14	7.0	76.0	0.3	0.3	76.7	7.0	83.7
Harricot...........	19	23.0	45.0	3.0	3.6	52.2	23.0	75.2
Peas	13	22.0	58.0	2.0	3.0	62.8	22.0	84.8
Beans	14	24.0	44.0	1.4	3.6	47.4	24.0	71.4
Lentils.............	14	29.0	44.0	1.5	2.3	47.6	29.0	76.6
Wheat Bread.....	44	9.0	49.0	1.0	2.3	51.4	9.0	60.4
Rye Bread........	48	5.3	46.0	1.0	1.4	48.4	5.3	53.7
Potatoes...........	74	2.0	23.0	0.2	0.7	23.5	2.0	25.5
Green Vegetables	86	2.0	4.0	0.5	0.7	5 0	2.0	7.0
Arrow-roots.......	18	...	82.0	...	...	82.0	...	82.0

In this Table the carboniferous matter is calculated as starch; 10 of fat being equal to 24 of starch.

other food which is rich in the defective substance. Our white meat, for example, is deficient in fat; we, therefore, eat bacon with veal, with liver, and with fowl, or we capon the latter, and thus increase its natural fat. We use melted butter with most kind of fish, or we fry them in oil; while the herring, the salmon, and the eel, are usually fat enough in themselves, and are dressed and eaten alone. It is with a view to similar adjustment that we mix eggs and butter with sago, tapioca, and rice; that we add oil and the yolk of an egg to salad; that we boil rice with milk, and eat cheese with maccaroni. The same instinct has determined the use of vegetables with meat, and butter with bread. Bacon and greens, like pork and peas-pudding, is a conjunction of viands which does not owe its popularity to old habit or the mere taste of the epicure; and so with a dish, common in Ireland, under the name of Kol-cannon; the potatoe, which is poor in gluten, and the cabbage, which is usually rich in this ingredient, are mixed together, and thus they approach the composition of wheaten bread, but both of these substances are deficient in fat; add, therefore, a little bacon or fat pork to the mixture, and you have a Kol-cannon, which has all the good qualities of the best Scotch oatmeal, and to many it is more savory and palatable. Again, the mixture so usual in Ireland and Alsace, of butter-milk or curdled milk and potatoes, and the combination of rice and fat which makes the diet of eastern nations; even the little dab of butter upon the poor man's potatoe, and the bit of cheese that he eats with his bread for dinner, are matters not of luxury but of necessity, and they show how by long experience we have at last learnt to adjust the proximate constituents of food, so as best to maintain the health and vigour of the body. "But when, through force of circumstances, or through a distorted taste, the natural instinct for such adjustment cannot be gratified, or is foolishly thwarted, the health is endangered, the constitution gradually altered, the temperament modified, life shortened, families extinguished, and whole races of men swept from the face of the earth."

There is a law of nature, therefore, which regulates these things; and, to use the words of Liebig, "it is the elevated mission of science to bring this law home to our minds; it is her duty to show why man and animals require such admixture in the constituents of their food for the support of the vital functions, and what the influences are which determine, in accordance with the natural law, changes in the admixture.

"The knowledge of the law elevates man in regard to an important function which he possesses in common with the lower animals, above the level of those beings which are destitute of reason, and supplies him, in the regulation of those bodily wants which are essential to his existence and prosperity, with a protection which the lower animals do not require, because in them the commands of the instinctive law are not opposed or overpowered by the allurements of sense or by a perverted and resisting will."

The recognition of this law, and the practical application of it to the dietaries of a community, are obviously of great advantage, for not only would they tend to increase the health and strength of the population, but they would also effect a great economy in the general use of food. That there are difficulties which stand in the way of such an application cannot be doubted; in fact, the natural peculiarities of individuals, to say nothing of the differences of occupation, and the ever-varying quality of the food itself, is enough to create a doubt as to the possibility of its general application until the progress of our science has gone far beyond its present position. Nevertheless, there are certain well-acknowledged facts at our disposal which may serve as a temporary guide to practice.

A healthy vigorous man consumes annually about 704lbs. of solid matter in his food, and yet the weight of his body remains constant. This large amount of food has therefore not contributed to the bulk of his frame, but has evidently been expended in the manifestation of force. It is true that during the whole time portions of his system have been constantly undergoing change—that they have been worn out by labour and as constantly repaired by food; but to disentangle the subject from all such complicated phenomena, it is evident that the ultimate destiny and purpose of the food has been the development of force. Ought we not, therefore, to have some knowledge of the relations between them? In other words, have we not here, as in physics, the means of ascertaining the relations between cause and effect.

Experiments on healthy men have shown that the daily consumption of the two principle elements of food—namely, carbon and nitrogen, are about 5,500 grains of the former, and 125 of the latter. These are contained in a diet composed of 12oz. of beef and 20oz. of bread, with about half an ounce of butter. According to some authorities, this quantity of food has, for an ordinary machine, a thermotic power capable of raising fourteen millions of pounds one foot high; but we find that when it is consumed in the animal machine, and that, too, under the most advantageous circumstances, the power is not more than three-and-a-half millions of pounds to the height of a foot. Even this is excessive labour; for, to judge from the work done by an active labourer, or by a strong criminal at the treadmill, it rarely exceeds two millions of pounds; in fact, the last worthy only lifts about one million of pounds to the height of a foot every day.

Looking, therefore, at the mechanical power of food in the human body, it is clear that a large amount of motive force is otherwise disposed of than in the outward manifestations of work. Much of this is doubtless used in the various massive and molecular movements of the internal structures, each of which demands an expenditure of power which cannot be rightly estimated. The beating of the heart, the movements of respiration, the friction of the circulating fluids, and the peristaltic action of the viscera are examples of these. In the exercise of the brain there is also an expenditure of force, and the loss of animal heat by radiation is also a loss of power; and little is known of these various deficiencies beyond the fact that in the aggregate of the day's work they amount to from $\frac{1}{4}$ to $\frac{1}{14}$th of the entire force of the body. Assuming, however, that a ration of food containing 5,500 grains of carbon and 125 of nitrogen is capable of developing enough available power in the human system to raise a weight of one million pounds a foot high, we have then a standard of working power by which we may estimate the labour value of the several dietaries now in use,

Another point of importance in the economy of food is the question that relates to the proportions of the several constituents of food that ought to be associated in order that the work of alimentation may be properly performed; for, as I have already said, experience has shown that there is a natural law which regulates the demand for the plastic, the respiratory, the fatty and saline elements of food; and whenever it happens that either of these is deficient or in excess, the process of alimentation is soon interfered with, and the functions of the whole system deranged. Human milk, which may be regarded as a model food, furnishes an indication of how much of these principles should be taken together. From that we conclude, that the proportions which are best suited for the wants of the animal system, are one part of the plastic to about three of the respiratory, and in the case of the physiological ration to which I have alluded, viz., the 12 ozs. of beef and 20 of bread, with half-an-ounce of butter, these are the proportions in which they are combined: but an examination of the table which I have drawn up, will show that these proportions rarely occur in any single aliment. Hence, the necessity for associating different articles of food so as to obtain the results indicated in the standard. Acting on the supposition that the nitrogenous elements are the most important, attempts have been made to represent the equivalent values of food according to the proportions of these substances contained in them, but all such attempts have failed to acquire a practical character because of the circumstance that the proportions of the other proximate principles are never constant. (See Tables I. and II.)

Table II.

Nutritive equivalents—calculated according to the amounts of nitrogen in the dry substances; human milk being 100.

Vegetable.		Animal.	
Rice	81	Human Milk	100
Potatoes	84	Cows' Milk	237
Maize	100	Yolk of Egg	305
Rye	106	Oysters	305
Radish	106	Cheese	331
Wheat	119	Eel	434
Barley	125	Mussel	528
Oats	138	Ox-liver	570
White Bread	142	Pigeon	756
Black Bread	166	Mutton	773
Peas	239	Salmon	776
Lentils	276	Lamb	833
Haricots	283	White of Egg	845
Beans	320	Lobster	859
		Skate	859
		Veal	873
		Beef	880
		Pork	893
		Turbot	898
		Ham	910
		Herring	914

If, in fact, it were desirable to tabulate substances according to the proportion of their plastic or nitrogenous constituents, then the figures in the eighth coloumn of my table would represent the per centage nutritive powers of such substances; but if it were required to tabulate them according to their value as respiratory foods, then the seventh column would be indicative of their strength; while the tabular arrangement expressive of their total per centage amount of nutritive power would be expressed in the last column. A very little attention to the proportions of the several nutritive elements as expressed in this table will indicate the kinds of combinations that should be effected in order to secure the proper proportions of the model or physiological standard. But here also the application of science must be controlled by practice, for, as Poggiale observes, the nutritive power of alimentary substances depends also on their strength, their cohesion, and their digestibility, and frequently a substance rich in alimentary principles, but difficult of digestion, nourishes less, and produces less strength than another matter easily dissolved by the digestive juices. Thus, meat nourishes much more than cooked white of egg, although these two substances possess the same composition. If we add to flour one-third its weight of water, it is found that we shall not produce the same physiological effects as with bread which contains the same principles. Gelatine is more nitrogenous than meat, and yet numerous experiments have proved that dogs die after several weeks of this exclusive regimen, whereas with meat alone they live much longer. Again, the nitrogenous principles of the corticle layers of corn, as the bran of wheat, rye, barley, oats, &c., are refractory to the action of the digestive organs of man. And, lastly, it has been proved again and again by experiment, that an artificial mixture of the several constituents of bread and beef have not the nutritive value of the natural substances. It is important, therefore, that all our theoretical results should be carefully controlled by practice.

This leads me to the question of the actual proportions in which these substances are associated in the several public dietaries of the country. (*Vide* Table, following page.)

The smallest amount of food on which a healthy man can exist, and that only for a short time, is the punishment diet in prisons of a pound of bread a-day with water. This furnishes 8·2 parts of respiratory, and 1·4 of plastic. It is manifest, even from theory, that these amounts of nutriment are not sufficient to maintain the integrity of the system. A man, therefore, placed on such a diet soon begins to feed on himself and to lose weight; in the course of three days he will, on an average, lose 3lbs. in weight; and in most of the prisons where a man is under long punishment, as for example, over two weeks, he has full rations every fourth day. If these were not furnished to him—his system, though perfectly inactive as regards bodily work, would get thoroughly out of repair. But little less nutritive is the diet supplied at the County and Borough Gaols of England to the prisoner who is to be confined for a period of not more than seven days. His daily rations of bread, meat, and milk, contain only about 2 ozs. of plastic matter and 12·4 of respiratory. Next in the series are the dietaries of the County and Borough prisons when the prisoner is confined for more than two months and is not kept at hard labour. These furnish about 16 ozs. of solid respiratory matter, and 3·1 of plastic. In the Scotch prisons the amounts are 19 ozs. of the former, and 3·4 of the latter; while in the Irish gaols, it is 20·5 and 3·4. When the prisoner is employed at hard labour the dietary in the English prisons is 3·5 ozs. of plastic and 18·2 of respiratory; in the Irish, it is 3·6 and 22·0; and in the Scotch, it is 4·5 and 27·0. The Unions of England employ dietaries which are exceedingly variable, but the daily average of them is 2·8 ozs. of plastic and 14·2 of respiratory. This is somewhat less in nutritive value than the dietaries furnished to destitute debtors; for the average of these is 3·1 ozs. of plastic matter and 16·3 of respiratory, so that the poor man who who has to seek parish relief after the hard struggle of a long life, is actually worse provided for than he who by careless or improvident habits has become the inmate of a prison. And worse still, the convict whose crimes have made him a curse to society, and whose labour while in prison does not produce above two pound ten a-year, is carefully tended in a comfortable home, and has daily a rich diet of 3·6 ozs. of solid nitrogenous matter, and 18·4 of respiratory. In short, as the table will show, the day's ration of an unfortunate inmate of a Union is only about 33½ ozs. in weight, while that of the debtor is 38 ozs., and that of the convict is nearly 48 ozs. Such a contrast in the comforts of the three classes is remarkable, and we cannot fail to see in it an encouragement to crime; in fact, when an unusual want presses upon the poorer classes, the effect of this temptation is seen in the crowding of the public gaols. So clearly was this shown during the late famine in Ireland, that it became the subject of legislative interference. I would not urge, however, that the diet of the criminal should be much reduced, but rather that the food of the pauper should be increased; for to judge from the results of practice, as well as from the indications of theory, it does not appear that an individual can sustain himself at ordinary labour on a diet that contains less than 4 ozs. of nitrogenous matter and 13 of respiratory. An apt illustration of this is given by Dr. Christison, in a recent report on this subject. The prison diet at Perth, for long terms of imprisonment, consists of 19 ozs. of carboniferous matter and 6 of nitrogenous—in all 25 ozs., according to Dr. Christison's scale. Now it was not only found unsafe to reduce this amount for ordinary sedentary occupations, but it was found also, that prisoners could not work for any length of time upon it; for when the men were employed in pumping water for the prison use, they soon gave way under it. An addition of 8 ozs. of meat and 6 of bread was found necessary, and then they all worked vigorously and cheerfully. Again, the calamities which befel our soldiers in the Crimea, show that the dietaries of working men cannot be safely reduced beyond the physiological standard. To use the words of Dr. Christison, any scientific person conversant with the present subject could have foretold, as a certain consequence, sooner or later, of their dietary, that the British troops would fall into the calamitous state of health which befel them in the Crimea.

TABLE III.

DIETARIES AND THEIR NUTRITIVE VALUES.

	WEEKLY CONSUMPTION IN OUNCES.							DAILY DITTO.		
	Bread or Biscuit.	Meat.	Potatoe.	Meal, &c.	Milk.	Cheese.	Butter.	Carboniferous.	Nitrogenous.	Total solid nutriment.
Physiological	140	84	...	...	...	...	3.5	12.7	4.0	16.7
Prison Punishment	112	...	...	...	...	...	...	8.2	1.4	9.6
E. County and Borough Gaols—										
Under 7 days	121	...	...	23	39.5	...	...	12.4	2.2	14.6
Not hard labour	172	7.8	3.2	22.8	15.4	3.5	...	16.7	3.1	18.8
Hard labour	163	14.6	63.4	27.2	41.6	1.5	...	18.2	3.5	21.7
Scotch Prisons—										
Under 3 days	112	...	...	28	...	...	...	11.2	1.9	13.1
Not hard labour	30	7.5	152	73	175	...	...	19.0	3.4	22.4
Hard labour	76	10	176	100	175	...	...	27.0	4.5	31.5
Irish Prisons—										
Under 1 month	56	...	192	70	70	...	...	19.5	2.9	22.4
Not hard labour	56	...	192	60	170	...	...	20.5	3.4	23.9
Hard labour	64	...	219	70.5	170	...	...	22.0	3.6	25.6
Military Prisons—										
Under 84 days	56	...	...	119	210	...	...	22.2	3.8	25.8
Over 84 days	56	...	...	168	210	...	...	27.8	4.7	32.5
Destitute Debtors	156	16	52	22	21	...	...	16.3	3.1	19.4
Convict Prisons	161	36	112	12	12.8	...	...	18.4	3.6	22.0
Unions (Adults)	112	15.5	51	17	34	5.2	1.1	14.2	2.8	17.0
Unions (Children)	90	14	32	...	105	...	3.5	11.1	2.3	13.4
Lunatic Asylums	114	23	68	16	14	7	1.3	13.2	4.0	17.2
Public Hospitals	93	52	56	14	7	...	3.2	12.1	3.5	15.6
Army—										
Crimea	112†	112	...	...	...	...	...	14.5	4.8	19.3
Home	168	84	112	...	...	...	...	19.4	4.8	24.2
Madras	112	112	56	4*	...	...	...	16.5	4.9	21.4
Bombay	140	112	56	56*	...	...	...	22.2	5.6	27.8
Field (India)	168	...	...	168*	...	...	...	30.7	3.8	34.5
Navy	112†	112	56	...	...	...	...	17.7	5.0	22.7
Navigator (Crimea)	140	140	...	28	...	...	...	17.8	6.2	23.0
Navigator (Home)	320	96	64	...	...	12	4	18.6	7.7	26.3
Berwickshire labourer	122	...	...	224	224	...	...	37.1	7.0	44.1
Yorkshire labourer	280	126	28	...	210	...	49	42.2	8.8	51.0

In this Table only the most important articles of diet are mentioned, although the others, excepting beer, spirits, tea, and coffee, are calculated in the daily consumption. (*) are rations of rice, and (†) are of biscuit. Gruel is calculated at rate of 2 ozs. meal per pint.

In the military prisons of England the dietaries for long imprisonments furnish 4·7 ozs. of plastic matter, and 27·8 of respiratory, while the food of the prisoner who is confined for a period of less than 84 days, contains 3·8 ozs. of plastic matter and 22·2 of respiratory. With this diet the prisoners generally lose weight; in fact, out of a total number of 3,420 prisoners that where discharged from the military prisons in 1854, there were 2,952 that had lost an average weight of 7 lbs. 9 ozs. per man; only 304 had gained in weight, and they acquired an increase of 2 lbs. and 13 ozs. per man; the rest had not altered in weight at all.

The ration of the British soldier varies with circumstances. Thus the home ration contains 4·8 ozs. of plastic matter and 19·4 of respiratory. At Madras, it contains 4·9 of the former and 16·5 of the latter; at Bombay, it is 5·6 and 22·2; while the field rations in India contain 30·7 ozs. of respiratory and 3·8 of plastic. The rations in the Crimea were only 14·5 ozs. of the former and 4·8 of the latter. This amount of the plastic material is the same as that contained in the soldier's rations when at home or in the colonies; but it is considerably less than the Bombay rations, where the soldier has not the necessity for the food which his great exertions demanded in the Crimea. The dietaries of sailors contain 5 ozs. of nitrogenous matter and 17·7 of carboniferous.

As a contrast to these which may be regarded as dietaries, which just serve the purposes of ordinary existence, I may refer to the dietaries of hard working men. The troop of navigators which performed the task of making the railroad in the Crimea, was daily supplied with 20 oz. of bread, 20 ozs. of meat, 2 ozs. of peas, 2 ozs. of rice, 1¾ ozs. of sugar, 1 oz. of coffee, and 4 ozs. of rum per man. These, exclusive of the rum and coffee, contain 6·2 ozs. of plastic matter, and 17·8 of respiratory; and the men used large quantities of food in addition, which they purchased on the spot. A navigator's weekly consumption when at home, is 20 lbs. of bread 6 lbs. of meat, 3 lbs. of potatoes, 12 ozs. of cheese, 4 ozs. of butter, 1 oz. of tea, 4 ozs. of coffee, 8 ozs. of cocoa, and 2½ gallons of beer, besides about 4 lbs. of fresh vegetables, and sundry drams of spirit; excluding the beverages, these rations give a daily supply of 7·7 oz. of plastic matter and 26·3 of respiratory. A Berwickshire reaper, according to Dr. Christison, consumes about the same amount of these materials; for his rations contain 7 ozs. of plastic matter and 37·1 of respiratory. But the largest feeder of all is the Yorkshire labourer, who consumes daily about 8·8 ozs. of nitrogenous food, and 42·2 of carboniferous. These ought to furnish the equivalent in labour of three million three hundred thousand pounds lifted one foot high.

The dietaries of our public hospitals are generally of three kinds, viz., low diet, middle diet, and full diet. The last of these contains 3·5 ozs. of plastic matter and 12·1 of respiratory. A middle diet is little more than half the strength of the former, at least in respect of the plastic elements; and in a low diet there is hardly ¼ of the nourishing material.

The dietaries of lunatic asylums are very variable, but the average of them is shown in the table; and it will be seen that a day's rations for a man contains 4 ozs. of nitrogenous matter and 13·2 of carboniferous. In a general way the dietaries of women are about one-seventh less than those of men, and the dietaries of children ought not to be much less than those of women. At a large institution in this metropolis, where many children at all ages are regularly maintained, the dietary contains 2·5 ozs. of plastic matter and 12·4 of respiratory; while that which has been recently sanctioned by the Poor Law Commissioners, as the dietary for the use of children in workhouses, furnishes 2·3 ozs. of plastic matter and 11·1 of respiratory.

In taking a general survey of the dietaries in use at different establishments, I have been struck with their great variations of quality and nutritive value. Taking for example the County and Borough Gaols of England, the daily allowances of food vary to the extent of many ounces. At Monmouth, for instance, the day's rations is 8 ozs. of bread, 14 ozs. of oatmeal, 8 ozs. of Indian meal and a pint-and-a-half of milk; while at Brecknock, it is 24 ozs. of bread, 3·4 ozs. of meat, 16 ozs. of potatoes, and 2 pints of gruel. The same kind of discrepancy exists in the dietaries of unions, hospitals, convict-prisons, and lunatic asylums. It is therefore of the utmost consequence that some fixed principles should be decided on for the direction of so important a matter. In the case of our gaols, the criminal, who is always well acquainted with the discipline of the several English prisons, will be apt, in the practice of crime, to make his selection of those localities where there is secured to him a comfortable and nourishing diet. Such inducements have a very pernicious tendency, and it is highly desirable that they should be abolished. Indeed, with a very slight knowledge of the resources of different places, it would be easy to fix upon a scale of dietaries that would be applicable to all occasions.

I do not mean by this, that it is possible, in the present state of our knowledge, to construct tables that shall at once indicate the nutritive or alimentary equivalents of different substances, so that failing in the supply of one, we shall be able to make it good by the substitution of another. This, as I have already said, is impracticable; for the relations between the several proximate constituents of different foods are very inconstant; and if we were to ask how much of meat, bread, rice, and potatoes may be substituted for each other, to supply the 2,000 grains of nitrogenous matter which are daily expended on an adult human body, the theoretical answer is 24 ozs. of the first, 51 of the second, 65¼ of the third, and 228½ of the fourth; but these quantities contain very unequal proportions of carboniferous matter, and hence their effects on the animal system is also very unequal, to say nothing of the fact, that in the act of appropriating them different amounts of labour would be demanded from the digestive organs. So also, in endeavouring to construct a table of nutritive equivalents, for the carboniferous matter contained in different foods, attention must be paid not merely to the relative proportions of fat, starch, and saccharine material, but also to the respiratory powers of these substances; for it is known that 10 parts of fat have the value of 24 of starch, or 25 of cane sugar, or 26 of fruit sugar, or 27 of spirit, or 77 of lean flesh; and experience shows us that these are the proportions in which they may be substituted for each other. A nation of hunters, and those who go naked and are exposed to great losses of temperature, consume large quantities of respiratory food; and if it so happens that the food is supplied in its least effective form, namely, as lean flesh, the quantity disposed of is enormous. The Hottentots, the Bushmen, and the inhabitants generally of Southern Africa are notorious for the large amount of food they consume. According to Barrow, they are the greatest gluttons on the face of the earth. "Ten of our Hottentots," he says, "ate a middling-sized ox, all but the hind legs, in three days; but they had very little sleep during the time, and had fasted the two preceding days. With them the word is to eat, or to sleep. When they cannot indulge in the gratification of the one, they generally find relief in flying to the other;" and the same authority, in speaking of the Bosjesmens, says they are as voracious as vultures. "The three who accompanied us to our waggons had a sheep given to them about five in the evening, which was entirely consumed by them before the noon of the following day." And those who have read the accounts given by Captain Parry, and others, of the gormandising powers of the Esquimaux, are familiar with the enormous quantities of food they can dispose of. Sir John Ross states that it amounts to 20lbs. of flesh and oil daily; and Captain Sir W. E. Parry once tried, as a matter of curiosity, how much food an Esquimaux lad scarcely full-grown would consume. In 24 hours he had 4lbs. and 4oz. of hard frozen sea horseflesh in the raw state, the same quantity of it boiled, 1lb. and 12oz. of bread and bread-dust, besides a pint and a quarter of rich gravy soup, a tumbler of strong grog, three wine glasses of raw spirits, and nine pints of water. But, as the late Dr. Pereira observed, the most marvellous account of a gormandising power is that published by Captain Cochrane, in his "Narrative of a Pedestrian Journey through Russia and Siberian Tartary." He says that the Russian Admiral Saritcheff was told that one of the Zakuti consumed in 24 hours the hind-quarter of a large ox, 20lbs. of fat, and a proportionate quantity of melted butter for his drink. To test the truth of this, the Admiral gave him a thick porridge of rice, boiled down with 3lbs. of butter, weighing together 28lbs., and, although the glutton had already breakfasted, yet did he sit down to it with great eagerness, and consumed the whole without stirring from the spot; and except that his stomach betrayed more than ordinary fulness, he showed no sign of inconvenience or injury. Captain Cochrane also states that a good calf, weighing about 200lbs., may serve four or five Zakuti for a meal. He adds, that he has himself seen three of them consume a reindeer at one meal, and that a Zakuti or Tingouse will easily devour 40lbs. of meat a day.

After such facts as these, it is not difficult to believe the assertion of Liebig, that if we were to go naked, like certain savage tribes, or if in hunting or fishing we were exposed to the same degree of cold as the Samoyedes, we should be able to consume half of a calf, and perhaps a dozen of tallow candles into the bargain daily, as warmly-clad travellers have related with astonishment of these people. In fact, the cooling of the body, by whatever cause, creates a demand for respiratory food, and he will best meet the requirements of the case who uses food rich in carboniferous matter.

Hence it is that the inhabitants of northern climates find a sustaining power in fats and oils, which is not possessed by any other kind of food; and Sir John Ross, in urging this on the attention of Arctic travellers, says, that the use of such food is the true secret of life in those frozen regions, and that the natives cannot subsist without it, for they become diseased and die with a more meagre diet. It is manifest, therefore, that the amount of respiratory matter contained in food is quite as important for consideration as that of plastic; and in all our endeavours to give a practical tendency to the theoretical results of science, attention must be paid to the more solid facts of experience, for he who constructs a table of nutritive equivalents, without regard to all the constituents of food, that is, to the chemical composition of it in its totality, fails to give a practical value to his labours. Even in the case of the least important of all the nutritive components of food, namely, the saline elements, it is not a matter of small importance as to whether they are present in right proportion or not, for they are contained in all the tissues and fluids of the body, and serve the purpose of giving solidity to the structures, and of acting as means of conveying nutriment into the system, and of carrying the wasted materials out of it. They are, therefore, among the prime agents of alimentation and secretion. Of all these elements common salt is the most important. Nearly half of the saline matter of our blood is composed of it; and though the food generally contains enough of this compound to supply the wants of the system, yet it is sometimes deficient of it, and then the necessity for a special supply is manifested by a craving which must be appeased; in fact, the use of salt as a condiment has always been clearly recognised, and has entered into the composition of every dietary. In some districts, where it is scarce, it becomes a valuable article of commerce, and even human life is bartered for it. Among the Gallas, for example, on the coast of Sierra Leone, the brother will sell his sister, and the husband his wife, for salt; and even in the more civilised parts of Europe it is made the subject of a tax; which Liebig truly says, is the most odious, the most unnatural, and the most disgraceful to human reason. Animals, urged by an instinct that is often superior to the boasted intellect of man, perceive the necessity for a free use of it. They will travel for miles to reach the salt lake or the briny spring, where their wants can be supplied; and from the accounts given by travellers, it appears that in many places where salt is not easily procured, the domestic animals perish for want of it. Warden says, that this is the case in the northern districts of Brazil, where the animals, deprived of salt, cease to be prolific, and then die. The experiments of Boussingault upon cattle, have also shown how important is the function of salt in nourishing the system. He found that when cows were deprived of it they got out of condition, the hair became rough and was matted together, bald patches appeared upon their bodies, and the temperament of the animals became cold and phlegmatic.

The other saline constituents of food are likewise of importance. Even the kind of salt contained in the water we drink may determine the kind of food that can be most economically appropriated. "Ireland," says Mr. Johnston, "presents us with a case in which this state of things appears to exist. The potato has become in a sense the national food of Ireland. This root contains larger proportions of potash and soda, but much less of lime and other mineral ingredients than either wheat or oats, which are the staples of English and Scottish life; but the greater part of the land is covered with a broad limestone formation, which impregnates with lime the spring and other water employed for domestic purposes, so that the mineral contents of what they drink supply the natural deficiency in what they eat. In this way it will appear that, the reasons for the adoption of a peculiar national diet may lie much deeper than political economy can generally go. It may depend upon refined chemico-physiological and chemico-geological relations, the discovery of which we may be very long indeed in arriving at."

The presence of a magnesian salt in the waters of certain districts of Europe seem to have an influence in producing disease. According to the recent investigations of Dr. Grange, there are two maladies, namely, goitre and cretinism, which appear in all climates, and among people of all habits; everywhere, in fact, are they observed but upon the sea-shore, and there is but one circumstance common to all countries in which these affections are found, namely, that the soil is composed of magnesian rocks. In France, Germany, England, and Sardinia, endemic goitre is found only in the districts of the magnesian limestone, where the waters contain an excess of magnesian salts. As other examples of the importance of the saline elements in food, I may refer to the mischievous effects of those foods which have been robbed of their natural saline matters, and to the results of an experiment made by the French academecians, who fed a dog daily on half-a-pound of boiled flesh, that had been previously soaked in water and pressed; in the course of 43 days the animal had lost one quarter of its weight, and after 55 days its emaciation was extreme.

These facts indicate the necessity for considering all the proximate constituents of food, and of giving to each its proper value in the theoretical construction of a dietary.

Again, it is of primary importance that the choice of a diet should not be dependent as much on the convenience of supply as on the requirements of the system. It is a remarkable fact, however, that these in nature are generally associated. Hence it is, that man in all parts of the globe finds in the produce of his own land ample and effective means of gratifying his wants. The cereals of Europe, as wheat, barley, oats, and rye, constitute the staple articles of diet with us; while rice is the most important food of Eastern nations, making the chief aliment of at least a hundred millions of persons. Maize is the principal food used by the Americans, and by the inhabitants of southern Europe, and of the Danubian Provinces; and everywhere the pulses or leguminous seeds are cultivated for their rich nitrogenous qualities. In the high table lands of Chili and Peru, the prolific quinoa forms the most available food; while here and there under a tropical sun, the banana, the plantain, and the sago palm, are the ready means of supplying our wants. All these substances exhibit peculiarities of composition which render them especially valuable in the localities where they are produced, and it will be seen by the table that their nutritive powers are very dissimilar. Wheat comes nearest in its proximate composition to the type of what our food should be, hence it is the most commonly used. Barley contains less nitrogenous matter than wheat, and its nitrogenous element has not so much the quality of gluten as of albumen. Barley, therefore, is unfit for the production of bread, but it makes good porridge. Rye, which is the food of Northern nations, makes a dark coloured bread, which has a disagreeable odour, and a sour taste, but it is highly nutritious, and keeps much longer than the bread from wheat. Oats make a substantial diet, which is particularly well suited for those who work hard. It is the principal food of the poorer classes in this country and in Scotland, and is generally used as porridge, or as cakes, because the bread from it is not light or spongy. It contains a great deal of fatty matter as well as gluten, and is therefore so very nutritious. Barleymeal, which is frequently substituted by fraudulent dealers for oatmeal, is not nearly so nourishing, and is a fraud not merely on the poor man's pocket, but also on his system. Maize, or Indian meal, like oatmeal, contains a large quantity of fat, but it is deficient in gluten, and will not make bread without the addition of wheat flour. It is, however, an agreeable diet, and is easy of digestion. When mixed with sugar and baked into cakes, it forms the food named Tassmanane by the Delaware Indians, who use it on their longest journeys. Rice is the least nutritious of all the cereals, for it is greatly deficient in fat and in nitrogenous matter. It cannot be made into bread, but is best cooked with butter, milk, and eggs, in the form of pudding. So slight is its nutritive, that even birds will starve upon it. Indeed, Poggiale found that strong fowls in good health were rapidly reduced by it in a few days. One bird lost 2,510 grains in twelve days, and another lost nearly 4,000 grains; while birds fed in a similar way with wheat rapidly increased in weight. It has been pretended that rice is the only aliment of the natives of India, but in reality it is associated with kari, which is a mixture of meat, fish, and vegetables. Quinoa has nearly the same composition as oatmeal; and the dhurra, or dhooria, of India, Egypt, and Africa, is much like that of wheat. The exact nutritive powers of banana, the plantain, and the sago palm are not known, but when in dry powder they have somewhat the nutritive value of rice. And with regard to the leguminous seeds, they are all rich in plastic or flesh-forming matter. A large quantity of this matter is easy of solution, and hence the meal of these substances makes good soup, but it cannot be formed into bread. The gram of the East is selected by travellers when they make their journeys across the desert, because of its light weight and its nutritive power. The lentil is the chief constituent of an expensive diet called ervelenta. Potatoes are far from being nutritious, although they constitute a large proportion of human food, and if they are not taken in conjunction with some substance rich in nitrogenous matter, they are hardly capable of supporting existence, though when mixed with flour and baked into bread, or eaten with butter-milk, cheese, or meat, they constitute a good respiratory diet. There is a remarkable similarity in the composition of the dry meal of rice, potatoe, and plantain; and the people who make use of these substances as their chief articles of diet, are characterised by a swollen condition of the abdominal region. This is the case with the Hindoos, the Chinese, the Negroes who feed on plantain, and the Irish. In each case the stomach must be enormously gorged, in order that the necessary amount of nitrogenous matter may be supplied to the system. All the true starches, or arrowroots, are wholly deficient in plastic matter, and cannot, therefore, be used as flesh-forming foods—they are only valuable as respiratory aliments. Fat also is devoid of nitrogen, but it serves a very important purpose in the animal economy, by promoting the alimentation of rich plastic food. Lehmann, who has paid much attention to this subject, says, "I was long since led, from theoretical grounds, to regard fat as one of the most active agents in the metamorphosis of animal matter; and this subjective conviction has since been converted into objective proof by numerous experiments regarding the fermentation of milk, namely, that this process cannot be excited by albuminous bodies in saccharine or amylaceous fluids, excepting with the co-operation of fat. I next ascertained that a certain, although small, quantity of fat was indispensable to the metamorphosis, and solution of nitrogenous articles of food during the process of gastric digestion. Elsasser has confirmed the fact by observation that, in experiments on artificial digestion, the solution of articles used in food is considerably accelerated by means of fat."

It is probable, also, that fat assists in the assimilation or appropriation of albuminous matter after it has left the stomach and has got into the general circulation, but of this we have no positive proofs. Muscular flesh or meat contains all the proximate elements necessary for prolonged and complete nutrition; and no artificial mixture of these elements will serve the same purpose for any length of time. Majendie, in his experiments, found that raw flesh from sheep's heads would preserve the health of dogs for months, but three times the quantity of chemically-prepared fibrine mixed with albumen and gelatine would not support life. There is, therefore, something in the organic combination of these substances in meat which renders it so perfect an aliment. Meat, however, requires an addition of respiratory food, and that to the extent of nearly twice its own weight; we, therefore, associate it with bread, potatoes, and rice. The albumen of eggs is still more nitrogenous, and requires fat or some other rich carboniferous material to bring it down to the normal standard of a good diet. The same also is true of blood, which contains a large quantity of albumen, and in preparing it for food, as in the case of black puddings, it is associated with rice or barley, and plenty of fat. Blood also contains the saline elements of food in large proportion, and if it were not that it is prone to undergo decomposition, and that it gives a disagreeable look to meat, and makes it hard on cooking, it would be advisable not to draw it from the animal at the time of slaughtering. In case of veal, the nutritive power of the meat is considerably reduced by the too perfect extraction of the blood. Fish approaches veal in its nutritive power, but it is much more easy of digestion, especially when it is not of the oily kind, and is, therefore, a favourite article of diet with the dyspeptic and the invalid. Lastly, milk may be taken as the natural standard of food, for it is the only material on which an animal can feed continuously. It doubtless contains the plastic and respiratory matters in those proportions which are best suited for the wants of the system, and the only drawback to its use with adults is the occasional indigestibility of the butter contained in it. When deprived of this by churning or skimming, or when mixed with farinaceous compounds, it agrees well with the stomach, and is very nutritious. The curd of milk or cheese is the nitrogenous portion of this fluid, and is, therefore, rich in plastic matter. When associated with bread and butter, it forms a staple article of diet. Old cheeses, which are in a state of decomposition, are thought to promote digestion, by setting up a molecular change among the contents of the stomach.

Experience has shown that there are certain articles of food which are not particularly nourishing in themselves, but which serve some very important purposes in the animal economy. This is the case with tea and coffee; in fact, the use of a vegetable infusion, containing astringent matter and an active principle, rich in nitrogen, has been almost universal among mankind from the earliest times. To use the words of Mr. Johnston, "the practice has prevailed equally in tropical and in arctic regions. In Central America, the Indian of native blood, and the Creole of mixed European race, indulge alike in their ancient chocolate. In Southern America the tea of Paraguay is an almost universal beverage. The native North American tribes have their Apallachian tea, their Oswega tea, their Labrador tea, and many others. From Florida to Georgia in the United States, and over all the West India Islands, the naturalised European races sip their favourite coffee; while, over the Northern States of the Union, and in the British provinces, the tea of China is in daily and constant use.

All Europe, too, has chosen its prevailing beverage; Spain and Italy delight in chocolate; France, and Germany, and Sweden, and Turkey, in coffee; Russia, Holland, and England, in tea—whilst poor Ireland makes its warm drink of the husks of the cocoa, the refuse of the chocolate-mills of Italy and Spain.

All Asia feels the same want, and in different ways has long gratified it. Coffee, indigenous in Arabia or the adjoining countries, has followed the banner of the Prophet, wherever in Asia or Africa his false faith has triumphed. Tea, a native of China, has spread spontaneously over the hill country of the Himalayas, the table lands of Tartary and Thibet, and the plains of Siberia; has climbed the Altais, overspread all Russia, and is equally despotic in Moscow as in St. Petersburgh. In Sumatra, the coffee leaf yields the favourite tea of the dark-skinned population; while Central Africa boasts of the Abyssinian chaat as the indigenous warm drink of its Ethiopian people. Everywhere unintoxicating and non-narcotic beverages are in general use among tribes of every colour, beneath every sun, and in every condition of life. The custom, therefore, must meet some universal want of our poor human nature! In fact, an unthought-of chemical instinct has guided men in the selection of these beverages long before any chemical knowledge existed of the substances contained in them. "What constitutional cravings, common to us all," says Johnston, "have prompted to such singular results? Through how vast amount of unrecorded experiences must these results have been arrived at!" And to bring this home to our individual experiences, who has not felt the exhilirating influences of a warm cup of good tea or coffee?

The physiological action of these beverages appears to be of a somewhat singular quality, for while they excite the brain, they calm the nervous system generally, and though they produce a state of wakefulness and activity, yet they also induce a species of languor and repose. Lehmann, who has inquired much into their physiological effects, has ascertained by experiment, that coffee greatly diminishes the wear and tear of the system; it oils the machinery as it were, and checks the waste of friction; for those who use it find that during active exercise the destruction of tissue is prevented, and that there is less demand for food; in fact, with a maximum of work to perform, and a minimum of food to accomplish it, he will best sustain his vital power who has resorted to a cup of tea or coffee. Hence its value as a means of economising food, and hence its importance to the poor labouring man; for it is a striking fact, as my great authority observes, that the poorest and humblest amongst us, who has his own little earnings to spend, devotes a small part of it to the purchase of tea or coffee. He can barely buy bread and milk, or potatoes and salt, yet the cup of tea or coffee is preferred to the extra potatoe or the somewhat larger loaf, and if thereby his stomach is less filled, his hunger is equally stayed, and his comfort both bodily and mental wonderfully increased. Besides the mere brickwork and marble, so to speak, by which the human body is built up and sustained, there are rarer forms of matter upon which the life of the body and the comfort of animal existence depends. This truth is not unworthy the consideration of those to whom the management of our public institutions is committed; and it is not an important question to solve, whether the lessening of the general bodily waste which would follow the consumption of a daily allowance of coffee or tea, would not cause a saving in bread and meat at least equal to the cost of the luxury; and with respect to the poor inmates of our Unions, it surely cannot be a misplaced humanity to minister to so innocent a craving of the almost worn-out body.

Another point of much importance in the economy of food is that which relates to the preparation of it by cooking, &c., for the results of inquiry show that the processes of cooking and otherwise preparing alimentary substances, have much to do with their digestibility and nutritive value. The experiments of Beaumont and others have proved that overdone meat takes a much longer time for digestion than that which is just sufficiently cooked; indeed the real objects of cooking are to soften the intercellular matters of food, to set by coagulation the fluid albuminous constituents, and to develop flavours which the raw aliment does not possess. The temperature at which this may be effected is not very high; for a heat of from 150° to 160° of Fahrenheit is sufficient not only to solidify the juices of flesh, but also to destroy their sanguinous appearance. In the process of cooking, therefore, the temperature should never exceed this point. The researches of Liebig have thrown a light upon this subject, and have endowed it with a practical and physiological importance. He has demonstrated that we cannot have at the same time a savoury bouilli and a rich broth. If it be desirable to obtain one, we must without hesitation make a sacrifice of the other; and he has furnished us with rules for the management of meat in either case. When it is required that the boiled meat should possess the greatest possible amount of nutriment and flavour, it must be treated in such a manner as to fix all the constituents within the mass. It is, therefore, to be suddenly plunged into boiling water, which will at once coagulate the albumen of the surface, and so lock up the minutest pores through which the juice of the meat would otherwise escape, and then if the temperature be reduced to about 160, and maintained at that point until the joint is uniformly heated throughout, it will be thoroughly done, and will have the softness, flavour, and elasticity of the most delicate viand. In the process of roasting the meat should first be placed very near to a sharp fire. This, as in the last case, will set the albumen of the surface; then it should be withdrawn to such a distance as will secure its being heated throughout to a temperature of 160°. When, however, it is desirable that a rich broth should be prepared, we must use those means which will secure the extraction of all the nutriment. The meat is to be finely chopped and digested in its own weight of cold water. After having macerated for a few hours, it is to be slowly heated to ebullition, and then, by gently boiling for a few minutes, the albumen is coagulated, and the broth separates as a clear fluid. It only requires the proper addition of a little seasoning and burnt onions to be converted into a delicious broth; and by further evaporation at a low temperature, it becomes concentrated, and at last leaves behind a brown extract, which possesses all the flavour of well cooked meat. This extract, when dissolved in about 30 parts of water, and flavoured with salt, yields at any moment a most excellent soup. All the shreddy fibres of the meat which have been separated by this process are tough, tasteless, and altogether wanting in nutritive power; in fact, the residue of the flesh of different animals cannot be distinguished from each other, for all the peculiarities of their flavour have been extracted in the broth. This confirms the view of Proust, that the peculiar constituents of broth exist ready formed in the flesh. The proportions of extract vary from ½ per per cent. for beef to 1½ per cent. for veal. A prolonged ebullition will extract more of the gelatinous matter, but will not increase the nutritive power of the liquor; in fact, gelatine imparts no taste to broth, and the experiments of the French academicians have proved that it is altogether wanting in nutritive power. Hungry dogs turn from it with loathing, and if, under the impulses of hunger, they are compelled to eat it, they soon become emaciated, and die with all the symptoms of starvation. M. Donne tried the effects of jelly upon himself, and though he took daily from 300 to nearly 800 grains of the dry gelatine in the form of a sweet aromatised jelly, yet in six days he had lost 2lbs. in weight, and during the whole time he was tormented with hunger, and suffered from great faintness, which nothing but a good dinner would remove.

Again, the investigations of Liebig demonstrate that the process of salting meat is very improper, for the brine extracts the juices of the flesh, and so removes most of the important constituents; in fact, salt junk, and the hard beef of the Navy have long been known as foods of very inferior value, and as being the cause of scurvy and other starvation diseases.

It is a matter of national importance how we can best preserve food without depriving it of its nutritive power, for by so doing we not only guard against the dangers of famine, but we also facilitate, even in times of plenty, the equal distribution of food. From the earliest times attention has been directed to this subject, but it is only since the date of our first Arctic exploration that anything of a really practical character has been made out. Then it was that the processes now so extensively practised were first put into operation; and as soon as the value of the preserved food became known it was employed, not merely for those purposes, and in those climates for which it was originally intended, but for a far more extensive object in all parts of the world. And now, at the tropics and at the poles, wheresoever man finds a habitat, there he has the means of supplying his wants. Thousands of tons of preserved meats and vegetables are annually exported from this country to our distant colonies, where food is scarce or perishable, and, conversely, there are many of our far-off possessions where the surplus food of a scattered population is made available for the wants of those who are at home.

This is not the time for discussing the rationale of the processes which are followed, but I may say that they are founded upon two principles, namely, the exclusion of atmospheric air, and the perfect desiccation of the substance. The former is usually applied in the preservation of animal substances, and the latter of vegetable. Both of them however are most easy of application, and their value cannot be overrated. In the case of vegetables, the preparations of Masson, Chollet Edwards and Makepiece are all that can be desired; and the preserved meats of Ritchie and McCall, Gamble, and others, have done good service.

In the preparations of the various flours or meals of grain, it is still a question whether there is any advantage in removing the husk or the bran. It is true that it contains a very large per centage of nitrogenous matter, but the real question is whether this matter is assimilable or not. Johnston, Liebig, and many others assert that it is, and they therefore recommended that whole meal should be used as food; indeed, the remarks of Liebig on this subject are very emphatic. The separation of the bran from the flour, he says, is a matter of luxury only, and is injurious rather than beneficial as regards the nutritive power of the bread. In ancient times, down to the period of the Emperors, no bolted flour was known. In many parts of Germany, especially in Westphalia, the entire meal, including the bran, is baked into the brown bread called Pumpernickel, and there is no country where the digestive organs of the population are in a better condition. On the other hand, Poggiale, who is a great authority on this subject, declares that the only use of bran is to retain food in the alimentary canal. Its composition shews that 39 per cent. of it are wholly unassimilable, and this he has proved by giving it to dogs, which lose weight by it. He has even found the bran unchanged in the matter discharged from their bodies; nay more, he has afterwards collected it and given it to other dogs, and then to fowls, so that it has passed through the systems of three animals successively, and yet it has remained unchanged. Still, however, it is an admitted fact, that a little bran in food favours assimilation, and, therefore, Poggiale recommends that about four per cent. of it should be retained. A too light bread, given to a robust young man who is exposed to hard labour, does not satisfy the cravings of hunger, and, although he may be well nourished, he does not feel that comfort and fulness of the body which a coarser diet produces; a small admixture of bran, therefore, with the food, may take off the attention of the stomach by engaging it in a somewhat severe labour. I have been told by Mr. Milner, who is the medical superintendent of the convict prison at Wakefield, that when the Scotch prisoners, who are accustomed to a poor and heavy diet of oatmeal, are passed into the English prisons, where the dietary is comparatively rich, they generally suffer for a time from a sinking sensation of hunger, as if the stomach felt the necessity for its wonted labour.

Many ingenious contrivances have been suggested for increasing the nutritive power of wheat flour; one of these has received the attention of practical men. It is the invention of M. D'Arblay, and is a means whereby in the process of grinding the flour, the meal may be separated so as to contain more or less than the average amount of gluten, and by the admixture of rivitts, or the hard wheat of Sicily, Russia, Sardinia and Austria, the per centage of gluten may be greatly increased. Flour of this description is, I am told, largely imported into this country, for increasing the nutritive power of our poorer varieties.

Another means of improving the alimentary value of wheat is, by mixing it with rich soup or extract of meat. This constitutes the patent process of Mr. Borden, whose biscuits contain about 32 per cent. of flesh-forming matter; in fact, a pound of biscuit contains the extract of 5 lbs. of meat mixed with half-a-pound of flour. An ounce of this grated into a pint of water, and then boiled and seasoned, makes an excellent soup.

Other modes of increasing the nutritive power of vegetables, are founded on the removal of their less valuable respiratory compounds. By the fermentation of potatoes, as is practised in Germany, the saccharine and starchy matters are converted into spirit, which is easily separated by distillation, and then the residue or dross contains all the gluten of the potatoe in an unchanged form, and is, therefore, valuable as fodder for cattle. It might even be mixed with the food of man, as an addition to the plastic elements. A similar process is followed in this country by Mr. Dray, who, manipulating with beet-root and mangel-worzel, obtains a high per centage of spirit and a valuable nitrogenous fodder.

In this country many thousand of cwts. of flour are annually used in the manufacture of starch; and, as the process is usually followed, all the rich gluten is lost; but by a contrivance, originated, I believe, by Mr. Orlando Jones, and practised by Durand and others, the gluten is extracted from the flour by an alkali, and is then precipitated in an edible form, so that it can be mixed with flour and made into bread. This, in the economy of food alone, is a valuable application of science.

I regret that I have not time to discuss the question of the relative digestibility of different foods, for this, in an economical point of view, is clearly of the greatest importance. Already the labours of Gosse, Beaumont, Schultz, Lallemand, Blondlot, Bidder, and Schmidt, have exposed a number of valuable facts, which might be made the basis of practical good. The general tendency of them has been to show not only that different articles have different degrees of digestibility, but also that the processes of cooking and preparing them have much to do with their nutritive power. The flesh of game and of young animals, and meat that is rather high, are more easily digested than that of others; so it is with the flesh of the heart, and of the viscera generally. This is due to the more tender condition of that investing tendonous matter which surrounds every fibre of muscle, so that the gastric juice quickly permeates and dissolves such tissues. A dish of tripe is an example of a loose albuminous tissue, which is easily dissolved. In one hour it is generally gone from the stomach, whereas a meal of beef or mutton will remain from three to four hours. The sarcolemna of salted meat is always hardened, and hence those foods require a long time for digestion, and frequently disagree with the stomach. The *true condiment* for such a diet is a little vinegar, which has the power of softening the tendonous structure, and of giving access to the digestive fluids. Pickles and cold beef are therefore associates in science as well as in experience.

A last point for consideration is the effect of over or under feeding on the animal system. Too much respiratory food favours the development of fat, and often checks the proper nutrition of the muscular tissues; hence it is that rice feeders and potato eaters, and those who indulge in fermented liquors, are often bloated in their appearance, and are not capable of prolonged exertion. The brewer's-drayman is a bad subject for the wards of a hospital, for though he usually has all the appearance of a man possessed of great muscular strength and vital endurance, yet it is not so in reality, for the muscular tissues have been encroached upon by fat, and the general power has been weakened by an undue influence of the respiratory element. Most of the animals in our menageries, from a too liberal allowance of respiratory food, die from fatty degeneration.

When the plastic constituents of food are in excess, the system becomes excited, as if from the development of force, and a savage disposition is often the consequence. A nation of animal feeders is always a nation of hunters, for the use of a rich nitrogenous diet demands an expenditure of power, and a large amount of physical exertion. Accumulation of the nitrogenous elements in the blood is often a prolific source of disease: in fact, very recently attention has been drawn to the diseases of over-fed convicts.

On the other hand, a deficiency of food quickly leads to the breaking up of the animal frame. Plague, pestilence and famine, are always associated in the public mind, and the records of every country show how closely they are related. The medical history of Ireland is remarkable for the illustrations of how much mischief may be occasioned by a general deficiency of food. Always the habitat of fever, it every now and then becomes the very hot-bed of its development. Let there be but a small failure in the usual imperfect supply of food, and then the lurking seeds of pestilence burst into frightful activity. The famine of the present century is but a too forcible illustration of this, for it produced epidemics which had not been witnessed in this generation, and it gave rise to scenes of devastation and misery which are not surpassed by the most appalling of the middle age. The principal form of the scourge was known as the contagious famine fever, and it spread, not merely from end to end of the country in which it had originated, but, breaking through all boundaries, it crossed the broad ocean, and made itself painfully manifest in localities where it was previously unknown. Thousands fell under the virulence of its action, for wheresoever it came it struck down a seventh of the people, and of those whom it attacked one out of nine perished. Even those who escaped the fatal influence of it were left the miserable victims of scurvy and low fever. Another example, not less striking, of the terrible consequences of what may be truly called famine, was the condition of our troops during the early part of their sojourn in the Crimea—with only just enough of food to maintain the integrity of the system at a time of repose, and at ordinary temperatures they were called upon to make large muscular exertions, and to sustain the warmth of the system in the midst of severe cold. What could be expected but that the scourges which wait upon famine, as fever, diarrhœa, dysentery and scurvy, should make their appearance in great force, and that the soldiers should perish by thousands. With an average strength of 24,000 men, the deaths from sickness alone, in the course of seven months, were at the rate of thirty-nine per cent., and in some cases it mounted up to seventy-three. "Never before," says Colonel Tulloch, "is there record of a British army having sustained so frightful a loss in so short a time." During the Peninsular War, though the troops occasionally suffered much from sickness, the loss from that cause did not average above twelve per cent. for a whole year. Even in the ill-fated expedition to Walcheren, which threw the nation into mourning, the deaths amounted to only about 10$\frac{1}{3}$ per cent. for the half year; and here, in this great city, with all the aggravating circumstances of want, vice, infancy, old age and disease, it did not reach to two per cent. during the time that our strong men were dying by thousands. "Armies have perished by the sword, and have been overwhelmed by the elements, but never, perhaps," says Colonel Tulloch, "since the hand of the Lord smote the host of the Assyrians, and they perished in a night, has such a loss from disease been recorded as on this occasion." May the lesson of so great a calamity be wisely applied to the future profit of the country!

DISCUSSION.

Dr. Lyon Playfair, C.B., F.R.S., in obedience to the call of the chairman, would open the chemical part of the discussion, or rather it could scarcely be called a discussion, inasmuch as the paper comprehended so much with which he agreed, that he had very little supplementary matter to state in relation to it. It was only quite lately—in fact, during the last few years—that they had really understood that the chemical force which is generated in our body was precisely the same chemical force which could be converted into mechanical force out of the body. Jould and Thompson had thrown much light on this subject, and it was only occasionally, as science diverged into different fields, that they could obtain information which enabled them to discuss the subject in the true spirit of philosophy. When they recollected what had been the amount of experience on the subject of diet since the period when Adam first plucked the fruits of Eden, they might be astonished that it was not until 12 or 15 years ago that they understood anything of the science of diet. They did not until then know what it was that formed the flesh and muscular tissues of the body—what parts of food gave heat, and what supported the respective functions. All this had been made known within the last few years, and although they might regret to find their large public bodies not coming up to the existing state of science in its applications to human well-being, it was still to be remembered that all our knowledge is of modern growth, and far from perfect. The chemical knowledge on this subject had, no doubt, advanced rapidly; although it was yet of the crudest character. The albumen of an egg produced flesh, hair, claws, tendons, feathers,—a number of parts of the body produced from the simple substance of albumen; but that was all one consideration as yet for the chemist. Physiologically they did not know how the albumen was converted into these parts. The human body was a machine which required force to work it, like a steam-engine; but there was this distinction between the body and a machine for manufacturing purposes, that the latter wasted its parts slowly by wear and tear, and it was not necessary that the parts should change by the manifestation of force; it produced certain results, but the parts of the engine remained unaltered. It was very different with the animal body, every manifestation of force caused the destruction of part of the structure of the machine; he could not raise his hand without part of the muscular action of the arm being destroyed by the motion; he could not have a sensation or thought of the brain without some change in the matter of the brain being produced by that thought, therefore the structural parts of animals were continually changing as a condition of their use, and in this respect the machine of an animal body differed from ordinary machinery. Now, what did the machinery of an animal consist of? A man of 150lbs. weight contained as much as 113lbs. of water, and only about 21lbs. of nitrogenous matter; he contained also about 6$\frac{1}{4}$lbs. of fat, and about 9$\frac{3}{4}$lbs. of mineral substance. How long was this machine to last? There was an old tradition with which they were all acquainted—that the animal body lasts for seven years, and then undergoes an entire change. If they took the average rate of waste in an adult human being, he would undergo a change in twelve weeks instead of seven years; that is, the rate of waste would destroy the fleshy structure of the body in twelve weeks—some parts more slowly, some parts more rapidly. The carbon would be burnt in the blood.

in that time. A man consumed about 2,000 gallons of air per day, or seven hundred weight per year, and this would burn the contents of the body as if they were put into the fire. The amount of air inspired would burn the whole carbon of the blood in three days, and unless the man had food, or unless the air acted upon the structures of the body, it was impossible for the machine to go on. Therefore they must produce force, as in a steam-engine, and they must supply the structures which were wasted. How much did it waste? If they took the public dietaries (and much had been done in that way)—if they took the experience of all nations, although with different descriptions of food—it resulted in giving a man in each case almost the same amount of nutritive ingredients. Take, for instance, the diet supplied to soldiers and sailors. Although the description of food varied in England and India, in Holland and in France, yet the result showed that the average quantity of nutritive ingredients supplied to soldiers was about thirty-six ounces dry flesh-formers per week, and in the navy, thirty-five ounces. The Dutch soldier, in time of peace, had only about twenty-four ounces of nitrogenous food per week, but he could not fight upon that, and in war the rations were increased to 35 ounces; so that what was termed "Dutch courage" had in reality some signification. He quite agreed with the author, that although that was sufficient, and represented fairly the amount of wear and tear of an adult man in a state of health and under ordinary labour, yet it did not represent the wear and tear of a man subjected to great bodily exertion; and therefore the 43 ounces of food taken by the navigators in the Crimea, and the 60 ounces taken by the Yorkshire labourer, (although he thought that was a poetical amount,) were cases in which the labour was exceedingly great. He would take 36 ounces of dry flesh-forming matter as a fair amount for an adult man performing an ordinary amount of labour, and from 70 to 74 ounces of carbon per week; and the proportion of carbon in flesh-giving matter to that in the heat-giving matter, should be as 1 to 3 in an adult man. The aged men in our hospitals and union-houses should receive from 24 to 28 ounces of dry nutriment per week, and from 72 to 78 ounces of carbon; and the proportion of flesh-giving carbon to that of heat-giving carbon, might be given as 1 of the former to 5 of the latter. For young persons—boys from 12 to 13 years of age—the quantity should be about 17 ounces of flesh-forming food, and 58 ounces of carbon, the proportion of the one description of carbon to the other being as 1 to 6, owing to the great amount of bodily exercise generally taken at that period of life, rendering a less quantity of heat-giving carbon necessary. He had apologised for the public dietaries as not having been much benefited by science, but in some cases they displayed the most extraordinary ignorance of the subject. He might mention the case in the Birmingham gaol, with which they were all familiar. The prisoner was deprived of the ordinary amount of food and put to crank labour. If he did not perform the stipulated quantity of labour, he was subjected to a further reduction in his food. This was much the same as if an engineer desiring to get more work out of a steam engine, instead of putting on more coals, raked the fire out of the furnace, and when the engine stopped from sheer inability to go on, he dashed it to pieces because it had stopped. There was one other point to which he would allude, which had only been just hinted at by the author, that was, however much they knew from science with regard to food, it would be dangerous to tamper much or too rapidly with public and national dietaries until they knew more upon the subject. The character of a people depended very much amongst other things upon the description of food they consumed. Though political institutions, race and other circumstances, no doubt, influenced character, the native food of a population was far from unimportant. In the case of a hunt we see an omnivorous animal—man —mounted on a graminivorous horse, accompanied by carnivorous animals, dogs, pursuing a vegetable-feeding hare, or a flesh-eating fox. Hence force might be had either from animal or vegetable food. But it was a different thing with regard to the temperaments of people and animals. The bears of India and America, which fed upon acorns, were mild and tractable; those of the polar regions, which fed upon seals and other flesh, were wild, untameable animals. Taking instances of people, the Peruvians, whom Pizarro found in the country upon his conquest, were a mild inoffensive people, subsisting principally on vegetable diet, whilst their brethren in Mexico, found by Cortes, were a warlike and fierce race, and eat animal food. The same might be said of the aborigines of Australia. Whilst living in their native wilds, and feeding entirely upon the produce of the hunt, they were wild and turbulent in their dispositions, but as soon as they were brought to a due proportion of both animal and vegetable food in the colony, they became mild, tractable, lethargic, and inoffensive, in fact died out. The Mahomedan population of India, subsisting purely upon flesh, were warlike, whilst the vegetable feeding people of Hindoostan were a quiet race and less warlike. The most striking illustration of this was afforded by Mr. Anderson, in the account of his recent travels to Lake Ngami. Passing through a country inhabited by a fierce tribe, in the extreme part of his journey, he came suddenly upon a corn-growing people, who had acquired the arts of peace, and who were mild and inoffensive, entirely unlike the savage tribes around them. Therefore, he contended, it would not do to alter too suddenly the food of a people without considering at the same time the probable influence on the character of the population. Mulder probably carried the idea too far when he said that the political changes and frequent revolutions which had taken place in France were owing to the *soup maigre*, a light and varied diet of the French, whilst the constitutional predilections of Englishmen were to be attributed to their beefsteaks and porter. One word in conclusion. Deficient as we still were in our knowledge, we had enough to enable us to form a tolerable acquaintance with the properties of food. But this would be of little use to us in our generation, unless the female portion of our population acquired that knowledge so as to impart it to those whom they educate. Men were, after all, poor educators compared with women. Women also were chiefly the feeders of men (although they had much higher functions in addition), therefore, unless women learnt as a part of their education the nature and composition of food, there was little chance of speedily diffusing that amount of popular knowledge which would enable the discoveries in the science of dietetics to be applied to the well-being of the human race.

Dr. Carpenter, F.R.S., would, in the first place, acknowledge how entirely physiology was indebted to chemistry for a knowledge of the value of foods. It was impossible to speak too strongly of the chemical researches in this direction for the last 15 years in clearing up much that was before doubtful, and putting the physiologist in possession of those principles on which a theory of food might be founded; and physiology must still look to chemistry on a great many points which must be more cleared up before that theory could be completed, but at the same time there were certain important facts in the physiology of food, which chemistry was not in a position yet to account for. He might instance the great importance of fresh vegetables; this was a point on which chemistry did not yet afford a satisfactory account. It had been supposed that a deficiency of potash in food was the cause of scurvy, which came on when fresh vegetables were withheld. He did not think the evidence in support of that doctrine was satisfactory; but certainly the influence of fresh vegetables in the cure of scurvy, was such that no medical man would be justified in substituting so many drops of liquor potassæ for a vegetable soup, seeing that in the one case there was a certain remedy for the disease, whereas in the other it was of doubtful value. The result of experience was, that the value of the different anti-scorbutics was not proportioned to the quantity of potash which they contained. Citric acid was better than no lemon juice at all, and even bad lemon juice was better than none. He adverted to this to show that there were some facts which had yet to be elucidated, and which were of the highest importance; for he held that the tables before them did not completely represent the relative values of foods in regard to all the requirements of the human system. Supply a man with flesh-forming food—fat and starch. and shut him up on board ship for 6 or 12 months, and if he had no fresh vegetables, he would certainly have scurvy. There was a circumstance which went to confirm this. During the year which followed the potatoe famine in Ireland, the high price of vegetables prevented their use as a diet to a very considerable extent, and the scurvy broke out in many poor-houses in this country. The American whaling-ships which went out on voyages of 3 or 4 years took out with them large quantities of potatoes, and if they fell short, they were served to the men in slices raw, to be eaten with vinegar; and whilst that was done, they bid defiance to scurvy. It was the duty of those who had the provisioning of ships for long voyages, to attend to so important a matter as this. A great deal of the mischief in the Arctic voyages, was owing to a deficiency of good lemon-juice. The supply had sometimes been of inferior quality. Sir James Ross returned from his exploration much sooner than the nation expected, and he was accused of not having used the exertions he ought to have done; but Sir William Burnett—the head of the Medical Department of the Navy, assured him (Dr. Carpenter), that if Sir James Ross had continued his search for another year, he would have lost the greater part of his crews from scurvy, for it happened that the lemon-juice at their command had very little value as an anti-scorbutic. They might administer citric acid and the alkaline salts, and the vegetable mucilage separately, but there was nothing like their natural combination in lemon juice: this combination being required to give those chemical products their highest efficacy as anti-scorbutics, just as the savoury principle of flesh was required to give the albuminous principle its nutritive value. But there was another point in which the living body was much beyond what chemistry or physics could account for. In the discussions which were going on with regard to the chemistry of food, and the mechanical equivalents of heat in the living body, there appeared to be a disregard of certain considerations which the physiologist knew to be of most essential importance. He need not dwell long upon the point of the constant waste going on in the animal body, this having been already adverted to. The body required food to sustain itself even in a state of perfect rest, whilst no mechanical force was being exerted, except the force involved in the circulation of the blood and in respiration. There was a muscular power given forth in those actions, and there must be an equivalent of force produced, but that would be comparatively small. The human body when at rest, excepting that small consumption, was undergoing a constant waste, which had no reference to the necessity of keeping itself warm. This waste is the result of that continual decay of the tissues which is a necessary condition of vital activity, and food is required in the first place to repair its results and to maintain the organism in working order. When work of any kind is done, this causes a proportional addition to the natural constant waste of the body. But there was something beyond this which had not been touched upon. It was one upon which physiologists had been enlightened during the last three or four years by experiments, viz., that in order to convert the food into living tissues, there needs a large waste of the food itself, the operations of sanguinification and secretion requiring an immense consumption of food. He would give two illustrations of this—one from the vegetable and the other from the animal kingdom, which the experience of all would apprehend. What was the meaning of the fall of the leaf? It was, that the leaves of plants were parts of the vegetable organisation, which were the makers of the solid structure, by bringing together the elements of the food—the oxygen, hydrogen, carbon, and nitrogen,—which they convert into the material of the solid substance of the stem. By the leaves the material of the wood was produced, and in producing that material for the growth of the permanent portion of the fabric, those transitory organs went through certain series or phases of life, and when these were accomplished they were cast off. That process was going on in the animal body, since, for the maintenance of the muscles, and brain, and bones, there was a very rapid succession of formations of soft tissues, which performed important functions in the process of assimilation, and those were temporary, as the leaves—only, instead of lasting, like the leaves, for several months, they only lasted for weeks or days. Hence, in the animal body, this fall of leaf, as it were, is constantly going on. He had spoken of the constant waste going on in the animal body irrespective of the work done, which was necessary for the maintenance of the body, as a living body, and that amount of waste could be measured by the amount of excretion in animals deprived of food and not put to exertion. That regular amount, day by day, could be ascertained. It would vary according to the amount of heat it was required to produce, but that element could be rendered constant. It was found that if an animal was only supplied with that quantity of food, it gradually loses in weight. Hence the quantity of food required to replace this necessary waste, was a great deal more than the necessary waste itself. If an animal were supplied with only the number of ounces of waste, it would at last be starved. It was found that the surplus proportion was different in different animals; from 150 to 200 per cent. being the quantity of food required to keep up the waste of an animal as compared with the weight which the animal loses when entirely unsupplied; or, in other words, nearly as much again of food was required to sustain the body in full vigour, as is actually applied to the construction of its tissues. He would now pass on to some other considerations which he thought had not received due attention; there were various kinds of work done by a living body—not only mechanical, but also mental. Many eminent physiologists were disposed to agree with him, that the work of the brain was just as much a tax upon the forces of the body as the work of the muscles. The brain wasted in preportion to the amount of thought or excitement of feeling, and wasted as much as the muscles in proportion to the wear and tear it undergoes. This mental force could not be measured by pounds weight lifted one foot high. Still he held that the mental pound was as much the product of food as the muscular forces, and the consumption of a certain amount of food was as necessary to the maintenance of the working powers of the brain as it was necessary to the maintenance of the muscular portion of the frame. Therefore he thought it was a misappropriation of ingenious calculation to draw a parallel between the working of a steam-engine or a galvanic battery, and that of the human body. They might as well say that a steam-engine did not do the whole work of the coal used because a great part of its force went out another way. The mechanical equivalent of heat in a steam-engine might be disposed of in the production of electricity. In fact they did know that the passage of the steam from the funnel developed a great quantity of electricity, but it was not collected as a force in the steam-engine. So in this calculation, with respect to the quantity of work done upon a given amount of food, they could only estimate the mechanical equivalent of that food. They might make the comparison between the amount of labour done by an agricultural labourer at 9s. a week, and the quantity performed by a labourer at 18s. per week, for the conditions might be nearly or quite the same. They might compute the physical work done by one man with that done by another, that would be quite a legitimate comparison, but it was not legitimate to compare what could be done by one man with a certain quantity of food with the work done by a steam-engine with the like amount of combustion. He would just state one point that was brought under his notice with regard to the influence of diet in connection with confinement. This required careful attention, being one of the points in which chemistry could not help, but in which physiological experience might show what was needed. Sir John Forbes, when travelling in Ireland a few years since, had been struck with the prevalence of ophthalmia in the Union Houses; he was impressed also with the idea that this disease was the result of insufficient nutriment. Mr. Wilde, a celebrated occulist of Dublin, was instructed to enquire into the matter, and he came to a similar conclusion. At the request of Sir John Forbes, he (Dr. Carpenter) examined the dietary scales of several Unions, and compared them chemically, according to the tables before the meeting, with the dietaries of the English poor houses; as regarded the amount of nutriment, and also as to its variety, he found that the total amount of nutriment of all kinds was not inferior to that which prevailed in most of the Union-houses in this part of the kingdom; but there was a difference in this respect, it was very uniform—gruel, oatmeal, maize, and potatoes, morning, noon, and night, usually no meat of any kind, and no variety of vegetables. It might be said this gruel, and oatmeal, and potatoes was the staple diet of the people of the country, and that in point of quantity it was better than they would get out of the Union-house. Yet there was something in the confinement, in the physical and mental monotony, which was shown in the case of prisoners and persons in Union-houses. It was different with those who lived free lives out of the Unions. There was something in the surrounding conditions which insensibly produced a most important influence in this respect, and, therefore, he held that it was not only the quantity and the quality of the food, but also its variety, which should be strictly attended to in the provisioning of persons confined within narrow spaces, without change of thought or occupation for long periods of time,

The Rev. Dr. **Booth**, F.R.S., could not permit a statement of one of the previous speakers to pass without expressing his entire dissent from it. Dr. Playfair gave it as his opinion that the character of a nation depended on the quality of the food it consumed, and instanced, as a proof of this strange assertion, the difference between the Mahometans of India who eat flesh, and the Hindoo population who fed on rice. But this difference was to be attributed rather to the indestructible characteristics of race, than to any difference in daily food. The Mahometans of India being of Mongol or Tartar descent, while the Hindoos are indigenous to the soil. Again, the Jews have had every variety of climate and food for the last 2,000 years, yet they have not changed in physiognomy, nor have the characteristics of the race been affected. These inherent qualities were far more deeply seated than Dr. Playfair imagined. Were it otherwise, questions of government and of reformation would be much simpler than they are found to be. We must not ignore the concurring evidence of all history, ancient and modern, should it stand in the way of an untenable and ill-considered theory.

Mr. P. L. **Simmonds** said that the physiological, chemical and mechanical aspects of the subject under discussion, had been so ably and justly spoken to by the scientific gentlemen who had preceded him, that he should probably best consult the views of the meeting by confining his observations to another phase of the question, the commerce and production of food, especially that of animals, with which he had lately been dealing in some of the agricultural publications with which he was identified. So late as Monday last, in a leading article of the *Mark Lane Express*, following with a series of papers on the importance of the dairy products, he had shown how largely cheese of home and foreign production was used as a food and condiment, and how important were its dietetic properties. The economy of food viewed in its various relations was a subject too vast to be dealt with in one evening, or, indeed, in many evenings' discussion, for every investigation and inquiry opened up new matter for consideration and experimental research. At the very outset of the discussion we were met by the inquiry of "What is food?" for the substances which are used as such, or may be called in for the sustentation of the vigorous powers of the body, are most heterogeneous, and varied in different climes and among different people. And here the old adage would occur to us, that "What is one man's meat is another man's poison." John Bull, however, though a hearty feeder, was rather nice in his eating, and somewhat bigoted and intolerant in his food prejudices. He had no penchant for foreign delicacies, but adhered with tolerable pertinacity to the animal substances which had become proverbial as the characteristic viands of the nation; and yet every race—every people of the globe—had some peculiar food-delicacy, and these curiosities of food he was enlarging upon last week in a lecture. It at least proved the adaptability of man to local circumstances, and evidenced the bounty and wisdom of the Creator, who had diffused animal life so carefully over the globe, that it enabled mankind to derive nutriment from the most heterogeneous substances of fish, flesh, and fowl. If a man, arrived at mature age, were able to summon up before him in bodily shape, the various animals which had fallen a prey to his carnivorous appetite, to meet the daily demand for his two pounds of solid food, he would be somewhat startled at their number and variety, and it would require a Noah's ark to contain them. The adaptability of the stomach was extraordinary, and although we might not relish the frogs, and the snails, and the horse-flesh of the continent, the monkey's flesh, alligators, and their eggs, whale and seal-flesh, polecats, iguana, lizards, and such like, of America, nor care to feast with the Africans on elephants' trunks and feet, lions and tigers, roasted snakes and locust bread or soup, we should be equally loth, probably, outer barbarians as we are, to partake of the Chinese messes enumerated by Sir John Bowring—of young puppies, cats and rats, sharks' fins and maws, sea-slugs, putrid eggs and edible birds' nests, or the fetid fish preparations of other Asiatics—dried mussels and prawns, and putrid fish pressed into a mass, with a "gamy" flavour to season their curries. However we might appreciate caviare and turtle, we should not care to taste the caviare of ant's eggs, so esteemed by the Mexicans, nor a slice of the sea-cow, eaten pretty generally in America, Africa, Asia, and Australia. There was no accounting for taste. But, apart from these novel articles of food, many of which would doubtless be gladly replaced by more wholesome substances were they at command, it cannot be concealed that there is a great waste of important articles of food in different localities, and also a great neglect in turning to practical application the important discoveries for the preparation and preservation of food which science has opened up to us of late years. It should be remembered, that the demand for animal food was increasing year by year, at home and abroad, and, as regards domestic live stock, scarcely keep pace with the increased means placed at their command by the large gold discoveries, and the more general diffusion of wealth. Every paterfamilias was conscious of the enlarged price of butcher's meat, and the daily wants of the mouths requiring to be fed. With all the increased exertions of our breeders and graziers, we yet had to import a large number of live animals, and a considerable quantity of cured provisions for the supply of our tables. The emigration of our population did not seem much to enhance our supplies; for, besides the diversion of labour from agricultural and pastoral pursuits in Australia, California, Canada, and other districts, the colonists became larger meat consumers. One instance, as telling directly upon our manufacturing interests, he might mention, namely, the check given by the gold discoveries to the former increase of sheep in Australia. While in 1852 there were six millions and a-half in the colony of Victoria, and the number had been increasing largely year by year, the want of pastoral labour and the demand for animal food had caused a decrease, and there were now scarcely 5,250,000 in the colony. Cattle-breeding had, however, increased, so as to meet the demand for animal food, and if we had less wool from thence, we might at least look for more hides. The preservation of animal food and the more general utilization of the food now neglected or wasted in the animals of the chase, the buffalos and wild cattle of North and South America, the wild sea-fowl and their eggs—the comparatively unreaped harvest of the fisheries, in various latitudes, were matters which he had prominently touched upon, two or three years ago, in a paper read to the members, for which the Society had done him the high honour of awarding their silver medal. The subject under discussion, as had well been observed, was not only of individual but of great national importance, nay, of interest to the world at large. The more, therefore, it could be ventilated—the more it could be examined—the more attention that could be paid to the nature, quantity, and quality of the food supplied to the people, the mode of cooking it, the means of preserving and storing it fresh for future use, and fitting it for transport to distant quarters,—the better would it be for the interests of society and of nations. Much remained to be done, and scientific investigations and popular discussion would do this by opening up new fields of research, and leading to new experiments and profitable and extensively beneficial results. The Great Creator had pronounced all that he made to be very good, but he left it to man to test, apply and economize the vegetable substances, and animals placed at his disposal.

Mr. Harries said, that as an officer of the Poor Law Board, the dietaries of Union-houses generally came under his observation; he could state that they had been formed and regulated upon data supplied by physiologists whose authority in such matters was unquestionable. He wished to ask Dr. Letheby whether he rightly understood him to say that the dietaries of prisoners were, generally speaking, more liberal than those of the inmates of Union-houses? His (Mr. Harries') experience was the reverse of that. In 1850, under the direction of Lord Ebrington, then Parliamentary Secretary to the Poor Law Board, he examined a large number of the dietaries in England and Wales, and the result was, to show an average of 22·16 ounces of nitrogenous ingredients per week, whilst he believed the prison dietaries on an average showed only 20 ounces weekly. He would remark that the general opinion appeared to be, that the dietaries of the Unions within the metropolis, were more nutritious than in the country; but he believed the fact to be, that the dietaries in the country around London were more liberal than the average of the dietaries in the metropolis.

Mr. Pittard said he was at present occupied as one of the officers of health of London. He thought the notice which had been given to the subject of scurvy ought not to be lightly passed over. There was danger, with persons not medically educated, of ranking the phenomena of scurvy with other ordinary diseases; but he would remark as a starting point on the subject of diet, that it was a singular fact that they might feed a man on capital diet, and give him plenty of strengthening food, and yet failing to give him fresh vegetables or their equivalent, he would fall into a wretched state of health. Mr. Pittard proceeded to give the result of his experience in various cases of the treatment of sea scurvy, and remarked upom the almost miraculous property of fresh vegetables, in effecting a speedy cure of that disease, giving instances within his own practice. He thought, with regard to the considerations of the health and well doing of the body, the natural tastes and instincts ought not to be wholly disregarded, but that within proper bounds much good frequently resulted from permitting their exercise.

Dr. Barnes was precluded, by the lateness of the hour, and by what had fallen from previous speakers, especially Dr. Carpenter, who had anticipated him, from going at any length into the subject. Dr. Letheby could not be fairly charged with dwelling too exclusively upon the fundamental element of food—time did not permit him to take in everything. It was, however, true that there were many elements of vital importance beyond those comprised in his Tables. Chemistry had not shown what the elements were that kept the blood in a healthy state, and prevented scurvy, but long before the recent advances in the physiology of nutrition, it was perfectly well known, empirically, how to prevent this disease. Captain Cook kept his crews in health by constantly procuring fresh vegetables, wild celery, and making beer with the tender tops of the spruce tree. With regard to the Crimean army, it was now well known that Dr. Andrew Smith had foreseen the necessity of providing lime-juice and vegetables, but our generals so managed that the men did not get them. There was one element of immense importance—iodine. He imagined Dr. Letheby must have made an error in quoting from Grange. Dr. Barnes believed that Grange, with Boussingault and Fourcault, did not attribute the origin of goitre and cretinism to the absence of magnesian limestone, but to the absence of iodine. It was ascertained that the wine of La Rochelle and the cereals of the Calvados, contained iodine, and that in those districts goitre and cretinism were unknown, whilst in some inland districts where the constituents of food contained no iodine, goitre and cretinism were prevalent. The quantity of iodine in our food must be infinitely small, yet it did not follow that it was not infinitely important. It had occurred to him that some of the value of guano might depend upon the iodine it contained. Salt had been adverted to by Dr. Letheby. He thought it possible that the salt we used was too much refined. It contained, he believed, no iodine. In some countries the salt was obtained from the evaporation of the sea-water; this might be more wholesome. The author had reflected upon the iniquity of taxing salt. It must, however, be remembered that not many years ago we taxed bread in this country; and we still taxed tea and sugar. Possibly the necessities of Government left no choice.

Dr. Letheby, in reply, expressed his gratification at the observations made by Dr. Lyon Playfair, whose chemical knowledge, as well as his special inquiries into this particular subject, gave great weight to the remarks which he had made. He was indebted to Dr. Playfair for the opportunity of showing, in a very clear and effective manner, the proportions of the several constituents of food in the dietaries of different nations, and of different classes of individuals, for the diagrams which were before the meeting were kindly lent for this evening by Dr. Playfair. Dr. Carpenter's observations were also entitled to great respect, by reason of the acknowledged eminence of their author; and there was but one point in those remarks to which he would refer. Dr. Carpenter stated that he thought it was a misapplication of ingenious calculation to parallel the working power of an engine and that of the human body, because we knew nothing of the actual power of the mental operations. The object of the comparison in the paper was not to show that we could estimate the actual amount of power exercised in the human body, but merely to show that of a large amount of developed power, only about $\frac{1}{14}$ was available for common labour. Now the intentions of the illustration were, first, that in demanding a certain amount of labour from a working man, we must take care that he is supplied with a quantity of food which experience shows is necessary for the performance of that work; and on the other hand, in furnishing a certain proportion of food to the convict, we may expect, if not demand, the equivalent of it in labour. The physiological relations of the question were purposely avoided, and the real or practical alone considered. In answer to Mr. Harries, who thought that there was an error in the conclusions deduced from the dietaries of prisoners and paupers, he would say that he had gone carefully over all the accessible dietaries of the two classes, and the general results were those indicated in the table. There were, however, great differences in both the quality and nutritive values of each class of dietaries, indeed, in the case of the dietaries of the county and borough gaols of England, there seem to be no rule observed beyond the mere fancies of the justices and magistrates of the different districts—and there was a like want of guiding principle in the construction of the pauper dietaries. To Dr. Barnes he replied, that he had misunderstood the tenor of his remarks on the subject of goitre and cretinism. Dr. Barnes thought it was urged that the salts of magnesia were wanting in the districts where those diseases were found, but the opposite was the case, namely, that there was a remarkable excess of those salts in the waters of those districts; and that, as there was no other circumstance common to the widely separated districts of those diseases, it had been thought by Dr. Grange that an excess of magnesian salts might have something to do with the production of the maladies. The remedy proposed by Dr. Barnes, namely, the use of iodide of potassium, was the remedy recommended by Dr. Grange, who advised that it should be mixed with all the salt sold in the districts.

Sir **CHARLES** Fox remarked, that through the means of these researches they might be able to arrive at the point when they could say, if they gave a man so much food, they might get a certain amount of work out of him. The present greatness of England depended upon the industry and labour of the people, and also from the fact that this country possessed a greater amount of machinery than any other. The brains and energies of Englishmen had been devoted to the improvement of machinery, but they had thought very little of the best mode of feeding a man to get the most labour out of him. It had been his lot to employ a great amount of labour in different parts of the world—in Spain, France, various parts of Germany and Scandinavia—and he had found that he never got so much labour out of any men as out of English workmen. On making inquiries with regard to the diets of different nations, he had come to the conclusion that this did not arise from superior talents on the part of the Englishman, but from the fact that, in France and Germany, the workman was not so well fed as in England. Although skilled labour fetched a higher price in London than in any other part of the world, yet the employer of labour found that nowhere could he expend his capital so profitably. It was a great moral question to see the human family well fed and well prepared to perform the important duties allotted to the human race.

The **CHAIRMAN** said, before performing the most pleasing part of his duty this evening, he would simply express a hope that some practical results would follow what they had heard that evening. He did hope with regard to the unfortunate aged poor, whose last refuge was the workhouse, that on economical motives—if for no higher sentiment, the old men and women might have their comfortable cup of tea or coffee. He did hope, too, that our great department of the philosophy of food—the prevention of waste—might be taken into the consideration by the ladies who had honoured them with their presence—particularly with regard to the instruction of the wives of the weekly-waged classes, to whom a knowledge of the principles of preparing wholesome food was most important. He quite agreed with the remark which fell from Mr. Pittard as to the value of the instinctive desires and longings. He had known healthy young people, after exertion of their muscular powers, express their very natural desire for cheese, and he had seen it refused by well-educated mothers as an improper article to be given them. Caseine was the substance which produced good muscular fibre in the human frame, and, in moderation, was one of the most healthy things a child could eat. He begged now to perform the very pleasing duty of asking the meeting to join him in a vote of thanks to Dr. Letheby for his admirable paper.

A vote of thanks was then passed to Dr. Letheby.

On the table was placed a great variety of preserved provisions, consisting of meat, soup, fish, vegetables, fruits, milk, bread, biscuit, egg, &c., contributed by Messrs. Brand and Co., 11, Little Stanhope-street, May-fair; John Henry Gamble, Morrisson's-quay, Cork; D. Hogarth and Co., Aberdeen, and 78, Cheapside; F. King and Son, 1, Bishopsgate-street; W. R. Mark, Spitalfields Market; John McCall and Co., 137, Houndsditch; Thurgar and Co., Albion Mills, Norwich; and G. Warriner, 38, Finsbury-square; to whom the thanks of the Society are due.

The Secretary announced that on Wednesday evening next, the 25th instant, a Paper by Mr. Christopher Dresser, "On a New System of Nature Printing," would be read.

MEETINGS FOR THE ENSUING WEEK.

MON. London Inst., 7. Rev. H. Christmas, "On the History and Antiquities of Heraldry; and on some other branches of British Archæology."
Architects, 8. Mr. J. G. Crace, "On Furniture, its History and Manufacture."
Geographical, 8½. I. Mr. Consul H. K. Abbot, "Journey in Persia from Shiraz to Darab and Kazeran." II. Mr. S. Sidney, "Proposed Search for Leichhard's Missing Party." III. Return of the North Australian Expedition under Mr. Gregory, to the East Coast." IV. "Chronological Table of the Earthquakes in the West Indies," &c. By M. Andrés Poez.
TUES. Royal Inst., 3. Prof. Huxley, "On the Principles of Natural History."
Meteorological, 7. I. Mr. Radcliffe, "On the Meteorology of Sinope." II. M. Poey, "On the Effects of Lightning in Connection with Photography." III. Mr. Glaisher, "On the Recent Hail Storms."
Civil Engineers, 8. Renewed Discussion on "High Speed Steam Navigation and the Relative Efficiency of the Screw Propeller and Paddle Wheels;" and, if time permits, Mr. F. R. Conder, Assoc. Inst. C.E., "On the Permanent-Way of the Bordeaux and Bayonne Railway, across the Grandes Landes."
Med. and Chirurg., 8½.
Zoological, 9.
WED. London Inst., 3. Mr. E. W. Brayley, "On Mineralogy and Crystallography."
Society of Arts, 8. Mr. Christopher Dresser, "On a New System of Nature Printing."
Geological, 8.
Archæological Association, 8½.
THURS. London Insti., 3. Rev. C. Boutell, "On the Fine Art and Antiquarian Departments of the Crystal Palace."
Royal Inst., 3. Prof. Tyndall, "On Sound."
Royal Society Club, 6.
Antiquaries, 8.
Royal, 8½.
FRI. Royal Inst, 8½. Mr. R. Warington, "On the Aquarium."

Sat. Royal Institution, 3. Prof. Phillips, "On the Limits of Variation in the State of the Globe—Geological Force and Time."
Medical, 8.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, March 13th*, 1857.]

Dated 19th February, 1857.

483. George Frederick Lee Meakin, 40, Albion-street, Hyde-park—An improved method of applying breaks to railway carriages.

Dated 23rd February, 1857.

520. Edward Robert Wood, Stouthall, Swansea—Improvements in labels.
522. Charles Alexis Bourdier and Victor Masselon, 4, Trafalgar-square—Improvements in obtaining and applying motive power.
524. James Brown, Aldgate—A method or methods of preparing paper to enable it to receive an impression from an engraved block or plate, type, or other printing agent, while in a dry state.
526. Giuseppe Devincenzi, Maddox-street—Improvements in producing figures and designs upon plates for printing from.
530. Charles Henry Murray, Oakley-cottages, Old Kent-road—An improved construction of chain pump.
532. Aimé Koch, Belfast—Improvements in machinery for breaking and scutching flax, hemp, and other fibrous substances.
534. George Barnett, 102, Aldersgate-street—Improvements in fasteners for parts of garments.

Dated 24th February, 1857.

536. Claude François Latruffe, 39, Rue de l'Echiquier, Paris—Improvements in heating apparatus.
538. Stephen Wright Hawks, Gateshead Iron Works, Gateshead-upon-Tyne—Improvements in railway chairs.
540. Joseph Robinson, Glasgow-terrace, Thames Bank, Pimlico—Improvements in the stages used in green-houses and hot-houses.
542. John Pullar and Laurence Pullar, Perth, N.B.—An improvement in the manufacture of umbrellas and parasols.
544. George McCallan, Johnstone, Renfrew, N.B.—Improvements in air and water discharge apparatus for steam pipes.
546. James Thornton, Belfast—Improvements in the manufacture of bricks, tiles, and tubes of earthenware.

Dated 25th February, 1857.

548. William Wood, Monkhill-house, near Pontefract—Improvements in machinery or apparatus used in the manufacture of carpets and other pile fabrics.
550. Job Mead and George Mead, Bethnal-green—Improvements in metallic packing boxes or cases.
552. William Edward Newton, 66, Chancery-lane—Improved machinery for making preparings from waste silk, cotton, wool, flax, hemp, and other fibrous materials. (A communication.)
554. Christian Schwedersky, Railway-place, Fenchurch-street—Improvements in floating ships or vessels.

Dated 26th February, 1857.

561. Thomas George Shaw, 35, Great Saint Helens, Bishopsgate—An improved thrashing and winnowing machine, which he calls flail thrashing machine for corn and other grain.
563. David Owen Edwards, Cambridge-villa, Gilston-road, West Brompton—Ventilating and removing the products of combustion of fuel and of respiration from the apartments of dwelling-houses and from public buildings.
565. Andrew Peddie How, Mark-lane—Improvements in machinery or tools for drilling and boring.
567. Joseph Slatterie Edwards, 233 and 234, Blackfriars-road—The preparation and novel application of a certain foreign fruit or vegetable as an article of food, confectionery, or to be used in brewing or distilling, or for the manufacture of sugar and gum.
569. Brook Hodgson and John Carter, Halifax—Improvements in looms for weaving Brussels carpets and other terry fabrics.
571. Walter Macfarlaine, Glasgow—Improvements in moulding or manufacturing cast-iron pipes.

Dated 27th February, 1857.

573. Godfrey Ermen and Francis Spencer, Manchester—Improvements in the manufacture of bands, straps, or belts, for driving machinery, and for other purposes.
575. William Robertson and James Guthrie Orchar, Dundee, and John Menzies, Ordie Mill, Perth—Improvements in machinery or apparatus for winding yarns or thread.
577. Edward Mucklow, Bury, Lancashire—Certain improvements in apparatus to be employed for the purposes of cooling and evaporating.
581. Samuel Draper, Lenton, Nottingham—Improvements in apparatus for retarding and stopping carriages on railways, and in cocks or taps used for such and other purposes.
583. William Edward Newton, 66, Chancery-lane—Improved valve gear for reciprocating steam engines whose power is applied directly by the piston without employing a rotary shaft. (A communication.)

Dated 28th February, 1857.

585. Edgar Heale and Mary Ann Heale, Albion-terrace, Hatfield New-town, Hertfordshire—The treatment of vegetable and other substances.
587. Jesse Briggs, Newsted Mill, Pudsey, near Leeds—Improvements in looms for weaving.
589. Thomas Horton, Birmingham—An improvement or improvements in the manufacture of mottled or variegated soaps.
591. James Edward M'Connell, Wolverton—Improvements in railway breaks.
593. Peter Armand le Comte de Fontainemoreau, 39, Rue de l'Echiquier, Paris—Improvements in window shutters. (A communication.)
595. Richard Archibald Brooman, 166, Fleet-street—An improvement in the manufacture of sulphate of soda. (A communication.)
597. Theodore Hyla Jennens, Hunters-lane, Birmingham—A new or improved manufacture of rollers or cylinders for printing fabrics.

Dated 2nd March, 1857.

599. Samuel Wright, Halstead, Essex—Improvements in gas regulators.
601. Thomas Parker, 34, Sitwell street, Derby—Improvements in railway wheels.
603. William Pedder, 4, Savage-gardens, Tower-hill—Certain improved methods of strengthening metallic and other structures.
605. William Henry Smith, M.D., Philadelphia, U.S., now of London, James Cadman, Maestig, Glamorganshire, and Joseph Cadman, Sandersfoot, Pembrokeshire—An improved method of manufacturing solid and hollow bricks, pipes, and other hollow and solid ware, from clay, shale, and other mineral substances.
607. Frederick William Mowbray, Bradford, Yorkshire—Improvements in weaving.
609. Charles Pauvert, Chatellerault, France—Certain improvements in manufacturing cast steel.
611. William Poupard, Wych-street—An improvement in buttons and means of fastening buttons to garments and fabrics.
613. David Patridge, Woolwich—Improvements in steam boilers.
615. James Anderson, West Bromwich, Staffordshire—An improvement in the process generally termed "gathering," used in the manufacture of certain kinds of glass.

Dated 3rd March, 1857.

619. John Banks, Northampton—A new description of life-preserver, adapted also to the preservation of property.
621. Georges Danré, Pierre Fortuné Victor Mouillard, and Pierre Adrien Mercier, Paris—An improved method of, and apparatus for, heating by gas.
623. Thomas Ball, Nottingham—An improvement in the manufacture of warp fabrics suitable for the manufacture of gloves.
625. William Edward Newton, 66, Chancery lane—Improved machinery for removing snow from railways. (A communication.)
627. William Taylor, How Wood, Renfrew, N.B.—Improvements in the manufacture of iron and steel.
629. Robert Mair, Edinburgh—Improvements in apparatus for protecting articles worn on the person.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

647. Thomas Burstall, Southall, Middlesex—Certain improved machinery for manufacturing bricks and tiles from clay alone, or mixed with other materials.—5th March, 1857.
674. George Philcox, 7, Stebon-terrace, Stepney—Improvements in marine and pocket chronometers and other time keepers.—9th March, 1857.

WEEKLY LIST OF PATENTS SEALED.

March 13th.

2149. Christopher Hill.
2155. Cornelius Ferguson Clements.
2171. Joseph Gilbert Martien.
2203. Edward Finch.
2655. Hugh Baines.
2671. William Green, jun., and Thomas Storey.
2984. Alfred Vincent Newton.
130. Matthew Andrew Muir and James McIlwham.

March 17th.

2172. Robert Burns.
2174. David Crichton and James Cathcart.
2175. John Barber.
2178. Alfred Lodwick Newman.
2182. John Muir Hetherington and James Gee.
2190. William Frederick Plummer.
2193. Charles Goodyear, jun.
2194. Jean Baptiste Honoré de Roussen.
2106. Charles Frederic Vasserot.
2198. Pierre Laffitte.
2213. Thomas Webster Rammell.
2215. Alfred Ford.
2216. George William Sayer.
2239. William Beatson.
2244. Joseph William Wilson.
2326. Charles Durand Gardissal.
2381. Robt. McConnell and Alexander Mackenzie.
2563. Edward Joseph Hughes.
2983. William Edward Newton.
2999. George Miller Clarke.
23. Nicolaus Chas. Szerelmey.
180. Thomas Kitelee.

696. Nathan Appleton Dyar, Massachusetts, U.S.—A new and useful composition to be applied as a covering to the sides and roofs of buildings, and for various other purposes.—9th March, 1857.

Patents on which the Third Year's Stamp Duty has been Paid.

March 9th.

684. Frederick Seiler.

March 10th.

576. Peter Armand le Comte de Fontainemoreau.

March 11th.

598. Lawrence Whitaker, John Diggle, and George Howarth.
603. Edward Haeffely.
910. Henry Brown.

March 13th.

629. Robert Weare.
641. George Harman Barth.

March 14th.

637. Rice Williams Harris and Thomas Patstone.